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Does dental undergraduate education and postgraduate training enable intention to provide inhalation sedation in primary dental care? A path analytical exploration

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ABSTRACT

Aim: To examine how quality standards of dental undergraduate education, postgraduate training and qualifications together with confidence and barriers could be utilised to predict intention to provide inhalation sedation.

Methods: All 202 dentists working within primary dental care in NHS Highland were invited to participate. The measures in the questionnaire survey included demographic information, undergraduate education and postgraduate qualifications, current provision and access to sedation service, attitudes towards confidence, barriers and intention to provide inhalation sedation. A path analytical approach was employed to investigate the fit of collected data to the proposed mediational model.

Results: One hundred and nine dentists who completed the entire questionnaire participated (response rate of 54%). Seventy-six percent of dentists reported receiving lectures in conscious sedation during their undergraduate education. Statistically significantly more Public Dental Service dentists compared with General Dental Service (GDS) dentists had postgraduate qualification and Continuing Professional Development training experience in conscious sedation. Only twenty-four percent of the participants stated that they provided inhalation sedation to their patients. The findings indicated that PDS dentists had higher attitudinal scores towards inhalation sedation than GDS practitioners. The proposed model showed an excellent level of fit. A multi-group comparison test confirmed that the level of association between confidence in providing inhalation sedation and intention varied by group (GDS versus PDS respondents). Public dental service respondents who showed extensive postgraduate training experience in inhalation sedation were more confident and likely to provide this service.

Conclusion: The quality standards of dental undergraduate education, postgraduate qualifications and training, together with improved confidence predicted primary care dentists' intention to provide inhalation sedation.

INTRODUCTION

Over the last couple of decades the Department of Health (1), the Royal Colleges in the United Kingdom (2), and the Scottish Dental Clinical Effectiveness Programme (3) have provided guidelines to inform the provision of quality conscious sedation in dental practice. In 2015, the Report of the Intercollegiate Advisory Committee on Sedation (4) replaced all previous clinical guidance (1-3). This latest guidance highlights the requirement for a patient-centred focus and emphasises that 'clinical provision [be] underpinned by the requirement for high standards of education and training for the entire clinical team.' (4). The report, therefore, states that practising clinicians must be knowledgeable in conscious sedation and undertake at least 12 hours of continuing professional development every 5 years for revalidation purposes. In addition to education and training needs, the report (4) emphasises that the practitioner must be able to make appropriate assessments of patients; must 'practice effective and safe conscious sedation' and 'remain calm, decisive and purposeful while handling difficulties or complications'.(4) This constellation of required skills suggests that practitioners providing conscious sedation need to be confident in their ability to assess and provide for the patient who presents requiring conscious sedation.

With an awareness of the need for high quality standards, as stated in previous (1-3) and current guidance (4), a National Health Service (NHS) Board located in a remote-rural locality, where primary care dental practitioners provided conscious sedation, wished to investigate the provision of inhalation sedation within primary dental care. From a theoretical perspective, and coincidentally from the most recent standards (4), it is important to determine the extent that past education (5-7) and training (8) of practitioners is associated with intentions to use inhalation sedation. The current literature has been equivocal about the relationship between education and training and the provision of conscious sedation (9-12). These investigators (9-12) have pointed to the role of barriers, other than education, which prevent practitioners from providing conscious sedation. These included the costs and provision of equipment and the time required to provide inhalation sedation. The question

remains, nonetheless, as to how these various dimensions of [1] dental education and training, [2] confidence in practical skills and [3] the potential barriers of equipment and costs; interact to affect practitioners' intention to provide inhalation sedation in the primary dental care setting. In order to investigate this question more fully, the NHS Health Board commissioned an audit of primary dental care practitioners to be undertaken. This would include questions to assess education and training, practical skills (confidence) and barriers (costs of equipment and time) and the relationship of these factors on practitioners' intention to provide inhalation sedation. Therefore, the aim of this part of the investigation was to examine how dental undergraduate education, postgraduate qualifications and training together with confidence and barriers could be utilised to predict intention to provide inhalation sedation.

METHOD

Sample

A non-probability convenience sample (13) of the dentists working within primary dental care (Public Dental Service and General Dental Service) in NHS Highland in 2014 were invited to participate. Participants were identified from the Primary Care Services list of dental practitioners who hold an NHS list number within NHS Highland.

Questionnaire

A multi-item paper formatted questionnaire in booklet form was prepared. It consisted of 4 parts:

[1] The first section examined the practitioners' age, gender, years since graduation, university attended and whether the practitioner worked in the NHS General Dental Service (GDS), in which the practitioner is paid under a continuing care and fee per item of service payment in the Public Dental Service (PDS) in which they are paid a monthly salary.

[2] The second part enquired of current provision, type of patients treated using inhalation sedation and access to inhalation sedation services on referral.

[3] The third part assessed training experiences in conscious sedation. This included items on previous undergraduate and postgraduate training in inhalation sedation as well as postgraduate qualifications in conscious sedation and any other postgraduate qualifications obtained.

[4] The final part was composed of 5 items to assess practitioners' attitudes and intention towards the provision of inhalation sedation. The intention to provide, and 2 confidence items (confidence to assess and confidence to provide inhalation sedation) were assessed on 5-point-Likert scales ranging from 1 (not at all) to 5 (definitely). Two items assessed the importance of time pressures and equipment costs (barriers) in governing the use of inhalation sedation. These were also assessed on a 5-point-Likert scale ranging from 1 (not at all important) to 5 (extremely important). 'Confidence to assess' and 'confidence to provide' items were summed to give a derived general confidence variable with scores ranging from 2 (not at all) to 10 (definitely) and the importance items ('time pressures' and 'equipment costs') were combined to give a derived barrier variable with scores ranging from 2 (not important at all) to 10 (extremely important).

Questionnaire design

The questionnaire design was based around those previously conducted by some members of the research team (14, 15). This format had proved to be both user friendly and was easily understood by dentists working in primary care.

Administration of questionnaire

Administration of the questionnaire followed a majority of the suggested steps to maximise responses to mail surveys (16) in that careful design, provision of prepaid envelopes, coding and a second mailing was carried out. Follow-up of non-responders was limited to one reminder letter after four weeks due to available administrative resources.

Participants were sent a personalised cover letter and the questionnaire along with the prepaid stamped returned addressed envelope. The completed questionnaires were handled and stored in accordance with University research governance policy.

Ethical considerations

The University of Dundee Research Ethics Committee granted ethical approval for the whole project 'An Audit of Sedation Service Provision in Primary Dental Care in NHS Highland' (UREC 13044). NHS Research Ethics was sent the audit protocol. The North of Scotland Research Ethics Committee deemed the project not to be research and so NHS Ethical Approval was not regarded necessary. The project was also registered with the NHS Highland Research and Development Department.

Statistical analysis

The data was entered onto an SPSS v21 database for analysis. The data was subjected to frequency distributions, χ^2 -analyses, t-tests, factor analysis and path analysis. The later method of analysis was performed using AMOS v21 which provides a flexible bootstrapping routine and a variety of essential fit statistics to interpret how well the data compiled match the authors' theoretical model.

Path analysis tested our hypothesised multiple mediational model to predict the intention to provide inhalation sedation in primary dental care (Figure 1). The model was executed as a series of boxed elements to signify all included variables. Arrows represented the likely direction of influence (17). The possible direction of causality can be inferred from the model presentation although this is merely used as a heuristic device and a suggested possible means of configuring the network of variables. It is recognised that there might be numerous alternative models that could have been fitted. However from our perspective the benefits of communicating this model and the results in this summary form has the ability to inform service provision. Model fit, that is, the ability of the raw data to fit the proposed model, was assessed using conventional indices including: the raw Chi-square value, the Comparative Fit Index (CFI), and a test of parsimony- the Root Mean Square Error of Approximation

(RMSEA). Values higher than 0.95 (CFI) and lower than 0.05 (RMSEA) are considered as excellent fit (18). Lagrange indices were also inspected to detect notable 'strains' in model specification. Bootstrapped standard errors were calculated to avoid bias from variables with non-optimal normal distributions.

RESULTS

Sample

Two hundred and two questionnaires were sent to all dentists working in primary dental care in NHS Highland. The overall response rate was 62%. When missing values were removed, the valid response rate was 54% (109). Of these, 51% of the practitioners worked in the PDS (56) and 49% (53) worked in GDS.

Demographic profile

Fifty-five percent of the practitioners were aged between 23 to 45 years and the remainder were aged between 46 and 55 years and over. Fifty-six percent (61) of the practitioners were male.

The majority of the practitioners had completed their undergraduate dental education at Scottish Universities - the University of Glasgow (40%), Dundee (19%), Edinburgh (5%). The remainder were trained at other universities (36%) e.g. University of Liverpool. Forty percent of the practitioners had been qualified for between 21 and 30 years, with the rest being qualified for fewer than 5 years (20%), 6-10 years (18%), 11-20 years (17%) and over 30 years (4%).

Provision and access to inhalation sedation service in primary dental care

Twenty-six (24%) practitioners stated that they provided inhalation sedation to patients. Among the practitioners who reported treating patients under inhalation sedation (26), 24 treated child or adult patients, 14 treated special needs child patients and 16 treated special needs adult patients. Of those

practitioners (73) who stated having access to inhalation sedation services, 27% (20) referred patients to Hospital Dental Service, 85% (61) referred patients to Public Dental Service, 1% (1) referred patients to General Dental Service (non-salaried with special interest) and 7% (5) referred patients to a Private Sedation Clinic. The most common dental treatments provided under inhalation sedation were extractions (92%) and fillings (77%).

Undergraduate training in conscious sedation

Seventy-six percent of practitioners stated that their undergraduate education in inhalation sedation was in lecture format. Fifty-four percent of these practitioners stated that they had hands on clinical experience in inhalation sedation.

Postgraduate and CPD training in conscious sedation

The number of postgraduate qualifications ranged from none to three with over one third of the practitioners having one postgraduate qualification such as MFDS (Membership of the Faculty of Dental Surgery). Sixty-six percent (72) of the practitioners had no postgraduate qualifications. Statistically significantly larger proportions of practitioners working in the PDS (50%) compared with the GDS (17%) had a postgraduate qualification ($\chi^2=13.24$: $P<0.001$). In fact only seven practitioners all from the PDS stated that they had the postgraduate diploma in Conscious Sedation. No statistically significant differences were found in the intention to attend postgraduate training in inhalation sedation between GDS and PDS practitioners. Overall, 46% (50) practitioners had attended CPD training on inhalation sedation. Statistically significantly larger proportions of PDS practitioners (72%) compared with GDS practitioners (28%) had attended CPD training on inhalation sedation ($\chi^2=15.73$: $P<0.001$).

Practitioners' intention, confidence, and barriers to providing inhalation sedation

Compared with GDS practitioners, PDS practitioners showed higher mean scores ($P < 0.05$) for intention, confidence to provide and confidence to assess patient need for inhalation sedation. In addition, GDS practitioners compared with PDS practitioners showed lower attitudinal mean scores ($P < 0.05$) towards the importance of time pressures and the importance of equipment costs to affect their decision to provide inhalation sedation (Table 1).

Testing of the model using path analysis

The hypothesised model (Figure 1) was constructed using the AMOS Diagrammer and consisted of distal (education and training) variables and attitudinal proximal (confidence and barriers) variables. All direct paths between distal and proximal variables were included. It was hypothesised that beliefs about confidence and barriers would be more closely associated to respondents' intention to adopt inhalation sedation and hence direct paths were included. As the same method of assessing confidence and barriers was used, that is multi-item rating scales, it was believed prudent to allow covariation of the error terms (referred to as 'disturbances') of these two variables to reflect systematic error due to the method of data collection. Bootstrapped estimates were requested (200 samples) to reduce bias from non-normal distribution of variables entered into the model. The number of discarded samples that were unable to be fitted was zero indicating the suitability of the model to the raw data. In addition no sample required more than 11 iterations for convergence. The level of fit was excellent and no Lagrange Index was highlighted as significant. The fit indices were as follows: $\chi^2 = 0.19$, $df = 2$, $P = 0.991$; CFI = 1.00, RMSEA = 0.001, (95%CI: 0.000, 0.001) (Table 2).

A multi-group comparison was run to test for the possible difference in the level of association between the parameter estimates of the relationship between confidence and intention to provide inhalation sedation in the two groups (GDS versus PDS). The resulting test found that there was a

statistically significant difference between the effect size of this relationship across the GDS and PDS groups ($\chi^2 = 7.35$, $df=1$, $P= 0.007$) (Figure 2a and 2b).

DISCUSSION

The aim was to examine how quality standards of dental undergraduate education, postgraduate training and qualifications together with confidence and barriers could be utilised to predict intention to provide inhalation sedation. The present work proposed a two stage model in which the quality markers of dental undergraduate education and postgraduate training would improve practitioner confidence, while reducing barriers and thus increasing intention to provide inhalation sedation (4).

It was interesting to note that over three-quarters of the practitioners had received undergraduate dental education in inhalation sedation (either lecture or hands-on), however, less than a quarter of practitioners provided inhalation sedation on a regular basis. Regarding undergraduate dental education in sedation techniques, the literature has suggested that hands-on clinical experience is more effective and will improve graduates' preparedness for future dental practice (5-7). This may explain why a number of practitioners do not provide inhalation sedation service although they have received undergraduate dental education in the subject area. Similar findings, concerning the type of undergraduate education (lectures vs hands-on experience) were found by Coyle et al (14). They suggested that it was not only the mode of teaching that affected knowledge and confidence but the quality of the hands on experience which was important in the prediction of willingness to provide special care dentistry in primary care. Other investigators have also suggested the need for high quality clinical experience at undergraduate level to promote available and accessible services from general dental practitioners (11, 19). Moreover when examining the dentists' confidence and the barriers of time and costs of equipment by practice type, PDS dentists compared with GDS dentists were more confident and intended to provide inhalation sedation. Therefore to investigate these observations more fully, a multiple mediational model was devised using path analysis to assess how

these associated enabling (i.e. dental undergraduate education and postgraduate qualifications) and inhibiting factors (i.e. time pressures and equipment costs) related to the intention to provide inhalation sedation in primary dental care. The result confirmed a highly consistent specification of the model to the raw data. This was suggested by a relatively low number of iterations for convergence and excellent fit indices with a low and insignificant chi-square value, a CFI index higher than 0.95 and the RMSEA index lower than 0.05 (18). In essence, the findings supported the hypothesis that undergraduate dental education and postgraduate training acted to improve the practitioners' confidence and postgraduate training reduced the influence of the barriers of time and equipment costs. The effect of increased confidence resulted in increased intention to provide inhalation sedation service.

With regard to service type, the differences in the associations and relationships of the variables in the model for each service group (i.e. GDS versus PDS), a multi-group comparison was conducted. This demonstrated a statistically significant difference between the effect size of this relationship between the GDS and PDS groups ($\chi^2 = 7.35$, $df=1$, $P= 0.007$). Statistical significances in the model for PDS dentists were shown in the association between postgraduate training and qualifications and confidence; and the association between confidence and intention to provide inhalation sedation. This suggests that for this group of PDS practitioners, the more postgraduate training and qualifications they had, the greater their confidence to provide inhalation sedation. However, no statistically significant associations were found with the intention to provide inhalation sedation for their GDS counterparts.

It may be proposed that this difference between the service providers was due to those working in the salaried PDS being provided with inhalation sedation equipment and having a monthly salary, compared with those in the GDS, who would have to provide their equipment and are paid on a fee-per-item of service. Thus the barriers of time pressures and costs of equipment did not exist for those within the PDS. This suggestion that increased provision and confidence, occurs as a result of available

inhalation sedation equipment is supported by the work of Daher et al (9) and Freeman and Carson (12). This research showed that possession of inhalation sedation equipment allowed the dentists to increase their skills and be more confident to practise inhalation sedation.

Although the GDS dentists perceived time pressures and equipment costs as substantial barriers to provide inhalation sedation, they still required the skills to identify, assess and make appropriate referrals to their PDS counterparts for treatment. Returning to the quality standards of dental undergraduate education and postgraduate training, we tentatively suggested that there is a need for all primary dental practitioners to be able to identify and assess patients who require inhalation sedation (20) – irrespective of whether or not they provide inhalation sedation. This reflects the report's recommendations for a highly educated workforce to be able to assess and refer to experienced colleagues to provide conscious sedation. However, recently there has been a shift in the General Dental Council's (GDC) requirement for undergraduate students from the need to 'have a range of practical experience in the administration of inhalation sedation . . . including assessment and preparation, care under treatment, and recovery and discharge of patients receiving conscious sedation' (21), to the current requirement for dental students to 'evaluate the risks and benefits of treatment under conscious sedation and make appropriate referrals', as stated in 'Preparing for Practice' (22). The GDC's educational requirement is for undergraduate education to focus on the assessment of the patient rather than providing conscious sedation. In agreement with other studies (5, 7), the findings here would support the view that postgraduate education, as part of continuing professional development and/or specialist training, provides an opportunity for primary care dentists to gain confidence in their clinical skills in conscious sedation.

The limitations of this study include only a moderate response rate so that it is not entirely clear if the model is representative of the whole population of dentists working in primary care within NHS Highland. While the response rate for this type of survey may be considered relatively good, it could have been further improved if additional strategies such as a provisional personal pre-contact with

the participants and an incentive had been given (16). Although representatives of primary care dentists, the model may not be generalizable outside a mainly 'rural and remote' geographical area. However, the model specification and ability to test this hypothesised formulation across other samples elsewhere internationally has prompted these authors to present this material to encourage further development and testing. The use of path analysis, we believe has enabled a clarity of presentation of a complex set of constructs and would commend other investigators to explore the benefits of this approach.

CONCLUSION

The quality standards of dental undergraduate education, postgraduate training and qualifications together with improved confidence predicted primary care dentists' intention to provide inhalation sedation.

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Table 1. Comparison of intention, confidence, and barriers between GDS and PDS practitioners towards inhalation sedation

Attitudes towards inhalation sedation provision	Means (95%CI) for GDS	Means (95%) for PDS	t	P value
Intention to provide inhalation sedation	2.38 (1.98, 2.78)	3.16 (2.76, 3.56)	-2.78	0.006**
Confidence: provision	2.04 (1.71, 2.37)	3.23 (2.85, 3.62)	-4.73	0.000***
Confidence: assessment	3.60 (3.37, 3.84)	3.93 (3.70, 4.16)	-2.01	0.047*
Barriers: time pressures	3.23 (2.81, 3.64)	2.34 (2.00, 2.68)	3.31	0.001**
Barriers: equipment costs	3.96 (3.68, 4.25)	1.86 (1.57, 2.15)	10.35	0.000***

*P<0.05

**P<0.01

***P<0.001

Table 2. Total sample (N = 109) bootstrapped unstandardised beta estimates with 95% confidence intervals of variable pairs drawn from hypothesised model

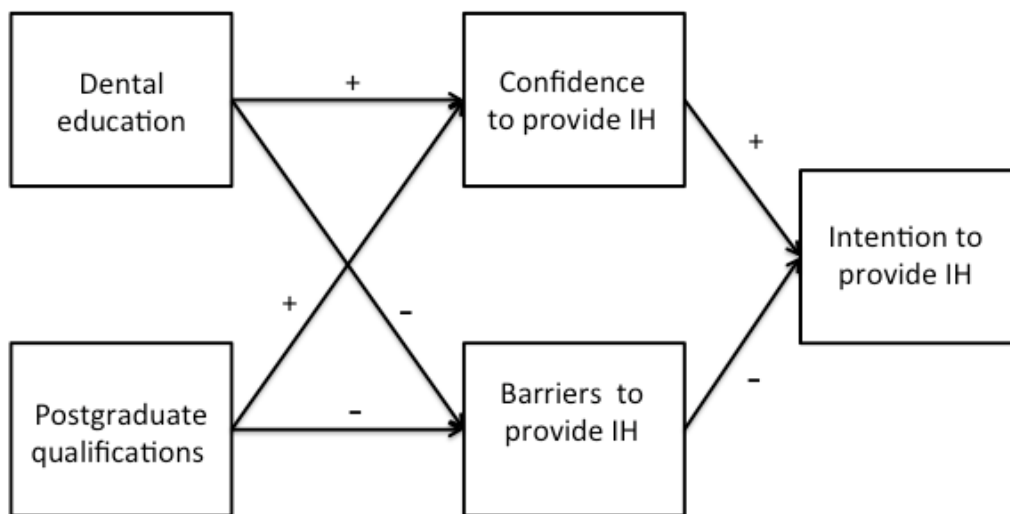
Variable pair specified in Model	Bootstrapped Unstandardised estimates	Bootstrapped 95% Confidence Intervals	P value
Dental UG Education → Confidence	0.66	0.22, 1.18	0.002**
Dental UG Education → Barriers to provide inhalation sedation	0.03	-0.51, 0.58	0.91
Postgraduate training & qualifications → Barriers to provide inhalation sedation	-0.88	-1.42, -0.31	0.006**
Postgraduate training & qualifications → Confidence	1.01	0.71, 1.47	0.00001***
Confidence → Intention to provide inhalation sedation	0.42	0.29, 0.53	0.00001***
Barriers → Intention to provide inhalation sedation	0.02	-0.07, 0.11	0.68

* P<0.05

**P<0.01

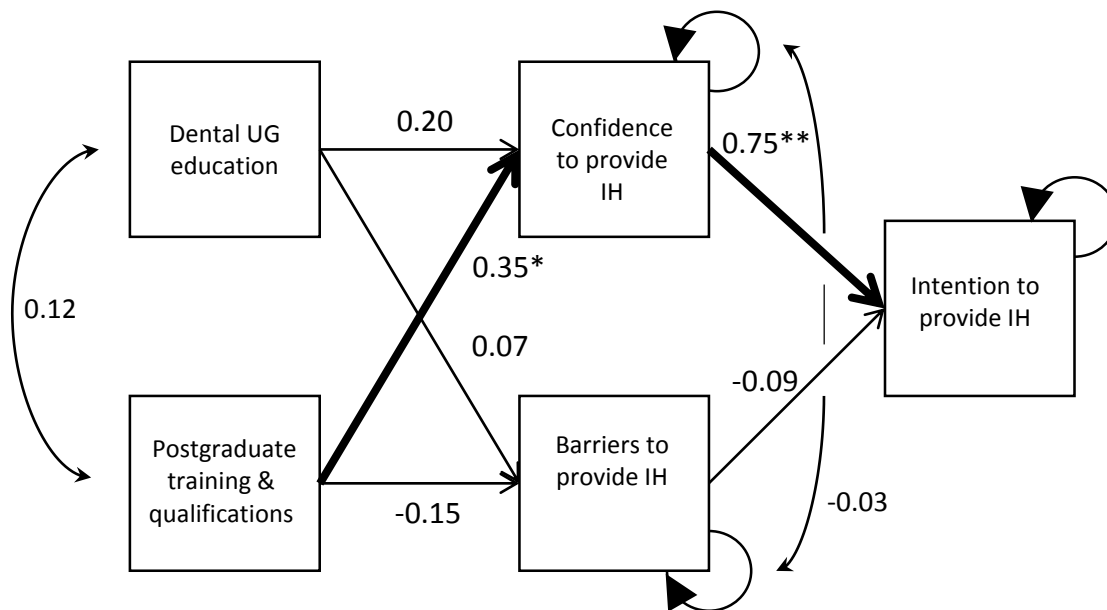
***P<0.001

Figure 1. Hypothesised model of intention to provide inhalation (IH) sedation
(+ = positive effect: - = negative effect)



Note: Indirect effects omitted

Figure 2a Prediction of Public Dental Service practitioners' intention to provide inhalation sedation

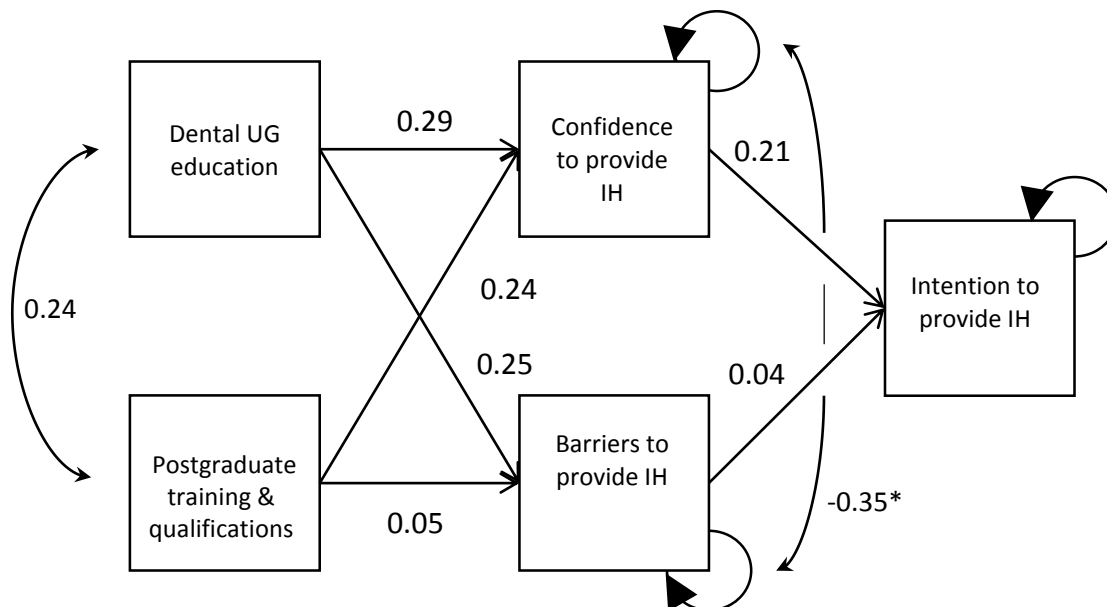


* $P < 0.05$

** $P < 0.01$

Note: Width of unidirectional arrows indicates significant effect. Variable error terms are denoted by circular arrows. Covariances included as double headed arrows. All parameter estimates included are standardized coefficients and can be interpreted as correlations.

Figure 2 b Prediction of General Dental Service practitioners' intention to provide inhalation sedation



Note: variable error terms are denoted by circular arrows. Covariances included as double headed arrows. All parameter estimates included are standardized coefficients and can be interpreted as correlations.

* $P < 0.05$